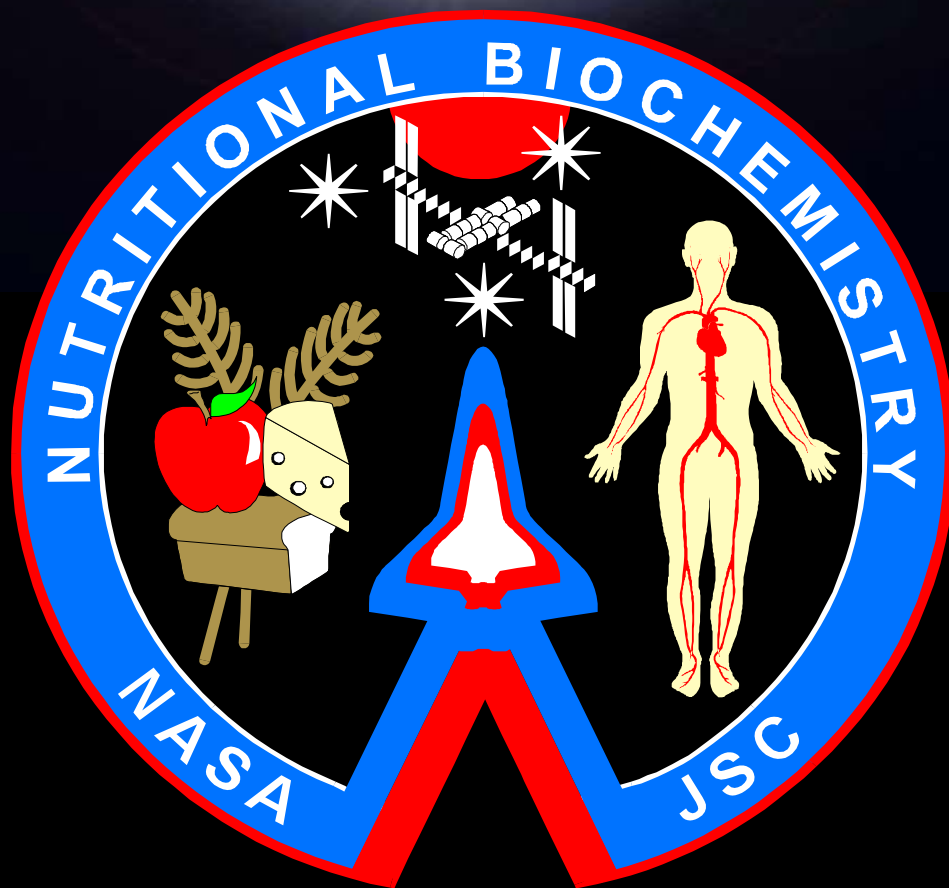
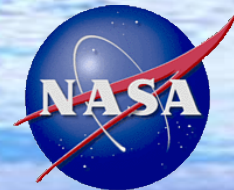


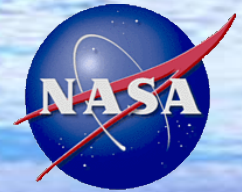
NASA Food & Nutrition: Updates from Space



Holly Dlouhy MS, RD, LD

Nutritional Biochemistry Lab

Dietitian's Role

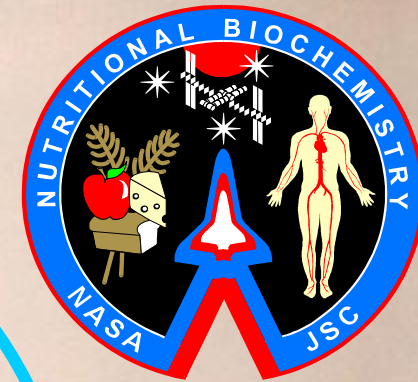


- ❖ Maintain Astronaut Health
- ❖ Menu Planning for Studies
- ❖ Counsel Astronauts on healthy eating
- ❖ Analyze Dietary intakes of the studies using Nutrient Data System for Research (NDS-R)
- ❖ Manage ISS FIT database
- ❖ Graph biochemical and nutritional data
- ❖ International Teleconference (CSA, ESA, JAXA, Russia)
- ❖ Assistance with conducting studies
- ❖ Food Debriefs

Space Nutrition



Space Nutrition



Nutrient Requirements

Energy
CHO (fiber), Fat, Protein
Fat-soluble vitamins
Water-soluble vitamins
Minerals
Fluid

Systems

Bone
Muscle
Cardio
Fluid/Electrolyte
Immunology
Hematology
Neurovestibular
Endocrine
GI
BHP
Vision

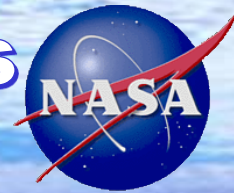
Countermeasures

Energy	Bisphosphonates
Amino acids	KCitate
Protein	Other Meds
Sodium	Exercise
Fatty acids	Other
Antioxidants	
Other	

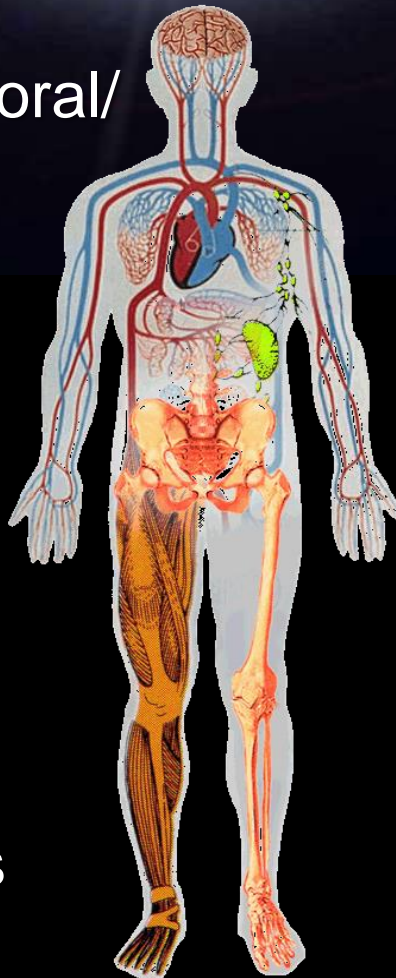
Vehicle/Mission

Duration
Food System
Radiation
EVA
Schedule

Adaptation to Weightlessness



- ❖ Psychological/behavioral/performance issues
- ❖ Sleep and circadian rhythm disturbances
- ❖ Neurosensory adaptations
- ❖ Cardiovascular adaptations
- ❖ Environmental issues



Physiological Changes that Impact Nutrition:

- ❖ Headward fluid shift
- ❖ Taste and odor sensitivity
- ❖ Bone loss
- ❖ Muscle/lean body mass loss
- ❖ Red blood cell mass changes
- ❖ Gastrointestinal changes
- ❖ Vision/ophthalmic Issues



БОРИСЕНКО РЫЖИКОВ

KIMBROUGH



WHITSON

PESQUET НОВИЦКИЙ





Peggy Whitson, Ph.D.



- ❖ Expedition 5 (2002)
- ❖ Expedition 16 (2008)
 - ❖ Accumulated 377 days
 - ❖ 6 EVA's (39 hrs 46 min)
- ❖ Expedition 50 (2016-present)
 - ❖ 1 EVA (6 hrs 32 min)
- ❖ Most Experienced Female Astronaut



The Science Behind Scott Kelly's #YearInSpace

Through research on astronaut Scott Kelly in seven major areas, we will improve our understanding of how the human body reacts to long-duration spaceflight. Testing began one year before his launch, intensified during his 340 days in space, and will continue for a year — or longer — after his return to Earth. The results of this research will help prepare us for future voyages beyond low-Earth orbit.

Visual Impairment

Has Scott's vision been impaired? Fluid shifts in microgravity can put pressure on the optic nerves. These investigations examine ocular health and the body's response to fluid shifts in a microgravity environment.

Human Factors

Will Scott's fine motor skills, which are important to controlling a spacecraft, diminish? These investigations also examine how astronauts interact with their environment aboard the International Space Station.

Microbial

Will the collection of microbes in and on Scott's body change in space? Environmental factors like stress and diet can affect the microbiome, which can — in turn — affect overall health. These investigations examine changes in the microbiome of astronauts during spaceflight.

Functional

Can Scott perform tasks such as opening a spacecraft hatch after landing or walking? These investigations examine the changes in an astronaut's performance of basic tasks and related psychological responses after 12 months in space.

Behavioral Health

Has living in space affected Scott's psychological health? Stressful environments can impair cognitive performance. These investigations measure reaction time, reasoning and mood.

Metabolic

With samples of blood, urine and saliva, we're getting a comprehensive look at Scott's overall health, including his immune system and nutritional status.

Physical Performance

How strong are Scott's bones, muscles and cardiovascular system? These investigations examine exercise capability with a focus on physical performance.

Learn more about every #YearInSpace investigation at:
www.nasa.gov/1ym/research



March 27, 2015-March 2, 2016



Duration: 340 days

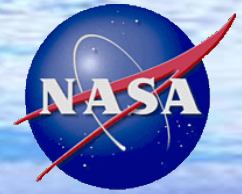
Orbits: 5,440

10,880 Orbital Sunrises & Sunsets

Miles Traveled: 144 million



Space Food History



Mercury Program (1958-1963)

Bite-sized cubes
Freeze-dried powders
Semi-liquids in tubes

Gemini Program (1962-1966)

Freeze-dried foods
Improved menu quality
Gelatin-coated cubes

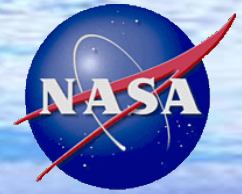
Apollo Program (1967-1972)

Hot Water
Eating utensils; Spoon bowl
Thermostabilized pouches



Spoon bowl

Space Food History



Skylab Program (1973-1979)

Menu 72 foods
Fridge/Freezer
Eating utensils



Shuttle Program (1981-2011)

Many commercially available foods
Large variety
Fresh foods

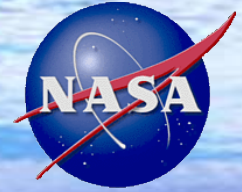


ISS Program (2000-Present)

Standard Menu Rotation
Bonus Foods
50% USOS and 50% RSA



Food System Issues



- ❖ Nutrient Content
- ❖ Palatability
- ❖ Shelf-Life
- ❖ Ease of Preparation
- ❖ Storage



❖ Thermostabilized Foods:

Heat treated to destroy harmful microorganisms



❖ Rehydratable Foods

Water added prior to consumption



❖ Natural Form Foods:

Nuts, granola bars, cookies



Irradiated Meats

Radiated to allow product to remain stable at room temp

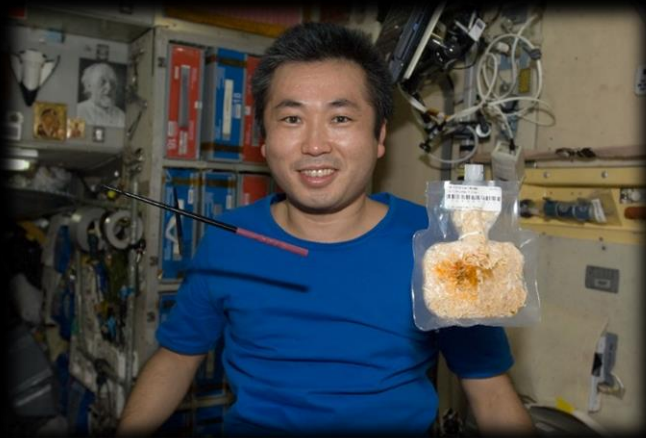
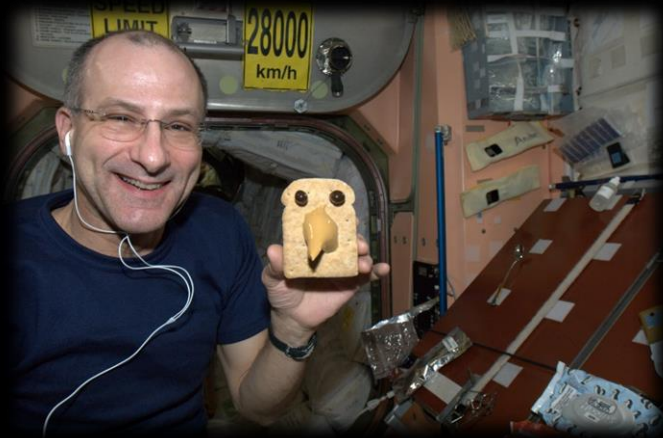


Fresh Foods

Delivered by various vehicles



- ❖ Variety of foods helps with:
- ❖ Food Fatigue
- ❖ Isolation from home
- ❖ Morale Booster





European Space Food



*Cottage Cheese with
Applesauce*



Baked Cabbage

Russian Space Food



Dried Apricots



Chicken Meal with Prunes

Is the food good?



Sensory Panel
done on all
foods, even
commercial
items.

Evaluated on:

Appearance

Taste

Smell

Texture



Sensory Panel

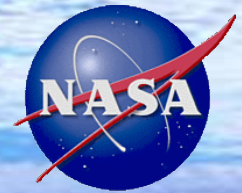
- ❖ At least 25 panelist needed
- ❖ Food Scored on a 9 point scale
 - ❖ (1-dislike, 5-netural, 9-extremely like)
- ❖ Tested at 3 time points:
 - ❖ Production, 1 year, 2 years



Food does not pass if:

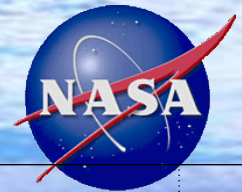
- ❖ It falls below a score of 6
- ❖ Score decreases by 20% between time points
- ❖ Losses 10% of nutrients over the time points

Standard Containers



		<u>Vegetable &</u>				<u>Rehydratable</u>	
<u>Side Dishes</u>	<u>Qty</u>	<u>Soup</u>	<u>Qty</u>	<u>Meat & Fish</u>	<u>Qty</u>	<u>Meats</u>	<u>Qty</u>
Baked Beans	3	Asparagus	3	Barbecued Beef Brisket	3	Beef Pattie	3
Black Beans	2	Beef Stew	1	Beef Fajitas	2	Beef Stroganoff	3
Brown Rice	3	Broccoli au Gratin	3	Beef Ravioli	2	Caribbean Chicken	3
Candied Yams	3	Cauliflower w Cheese	3	Beef Steak	3	Cashew Curried Chicken	3
Carrot Coins	2	Chicken Noodle Soup	1	Beef Tips w/ Mushrooms	2	Chicken Pineapple Salad	3
Corn	3	Crn Mushroom Soup	1	Cheese Tortellini	1	Noodles & Chicken	3
Cornbread Dressing	3	Creamed Spinach	2	Chicken Fajitas	3	Pasta w/ Shrimp	3
Mac and Cheese	3	Curry Sauce w/ veggies	3	Chicken in Pouches	2	Shrimp Cocktail	3
Mashed Potatoes	3	GrBeans & Mushrooms	2	Chicken Strips in Salsa	2	Shrimp Fried Rice	3
Pasta w/ Pesto	2	GrBeans & Potatoes	2	Chkn w/Corn, Black Beans	2	Sweet & Sour Chicken	3
Potato Medley	2	Italian Vegetables	3	Chicken w/ Peanut Sauce	2	Teriyaki Chicken	3
Potatoes au Gratin	3	Lentil Soup	1	Crawfish Etouffee	2	Turkey Tetrazzini	3
Red Beans & Rice	3	Minestrone Soup	1	Fiesta Chicken	2	Vegetarian Chili	3
Rice Pilaf	2	Mixed Vegetables	3	Grilled Chicken	2		
Rice with Butter	3	Potato Soup	1	Grilled Pork Chop	2		
Southwestern Corn	2	Spicy Green Beans	3	Lasagna w/ meat	2		
Wheat Flat Bread	3	Split Pea Soup	1	Meatloaf	2		
Wild Rice Salad	3	Teriyaki Vegetables	3	Salmon	2		
		Tomato Basil Soup	2	Seafood Gumbo	2		
		Tomatoes & Artichokes	2	Smoked Turkey	2		
		Tomatoes & Eggplant	3	Sweet & Sour Pork	2		
		Vegetarian Veggie Soup	1	Tuna	2		
				Tuna Salad Spread	2		

Standard Containers



<u>Fruit & Nuts</u>	<u>Qty</u>	<u>Desserts & Snacks</u>	<u>Qty</u>	<u>Breakfast</u>	<u>Qty</u>	<u>Beverages</u>	<u>Qty</u>
Almonds	3	Apricot Cobbler	3	Blueberry Raspberry Yogurt	2	Apple Cider	4
Apples w/ Spice	3	Banana Pudding	3	Breakfast Sausage Links	1	Brkfst Drink, Chocolate	3
Applesauce	3	Bread Pudding	3	Cheese Grits	2	Brkfst Drink, Strawberry	2
Cashews	3	Brownie	3	Cornflakes	2	Breakfast Drink, Vanilla	3
Citrus Fruit Salad	3	Butter Cookie	6	Granola	2	Cocoa	3
Crackers	8	Butterscotch Pudding	3	Granola w/ Blueberries	2	Drinking Water	25
Dried Apricots	3	Candy Coated Almonds	3	Granola w/ Raisins	1	Grape Drink	3
Dried Peaches	3	CandyCoated Choc.	3	Grits w/ Butter	2	Grapefruit Juice	4
Dried Pears	3	Candy Coated Peanuts	3	Maple Top Muffin	3	Green Tea	4
Fruit Cocktail	3	Cheddar Cheese Spread	3	Mexican Scrambled Eggs	2	Green Tea w/ sugar	4
Macadamia Nuts	3	CherryBluebry Cobbler	3	Mocha Yogurt	2	Hint of Lemon	10
Peaches	3	Chocolate Pudding	3	Multigrain Cheerios	2	Hint of Lime	7
Peanut Butter	6	Choc Pudding Cake	3	Oat Cereal	2	Hint of Orange	10
Peanuts	3	Cranapple Dessert	3	Oatmeal w/ Brown Sugar	2	Lemonade	3
Pears	6	Dried Beef	3	Oatmeal w/ Raisins&Spice	1	Lemon-Lime Drink	2
Rhubarb Applesauce	3	Granola Bar	3	Sausage Pattie	2	Mango-Peach Smoothie	6
Strawberries	3	Lemon Curd Cake	3	Scrambled Eggs	2	Milk	12
Trail Mix	3	Lemon Mereng Pudding	3	Seasoned Scrambled Eggs	2	Orange Drink	2
Tropical Fruit Salad	3	Nut & Fruit GranolaBar	3	Vegetable Quiche	2	Orange Juice	6
+9 crew		Rice Pudding	3	Waffles	3	Orange Mango Drink	3
preference		Shortbread Cookies	3			Peach Aprioct Drink	2
containers per		Tortillas	26			Pineapple Drink	3
6 months		Vanilla Pudding	3			Raspb Lemonade w/A/S	4
		YogurtCoverGranolaBar	3			Tropical Punch	3

Food Frequency Questionnaire (FFQ)



Frequency Questionnaire

User: SMS Expedition 15 Number of Packets

Fruit=====

Dried fruit, fruit roll-ups, prunes

Kuraga, mashed dried apricots, prunes..... ☐

Cobbler, cranapple dessert..... ☐

Other fruit, like apples with spice, applesauce, berry medley, fruit cocktail, mandarin oranges, mixed fruit, peach ambrosia, peaches, pears, pineapple, strawberries

Apple cranberry sauce, apple dessert, cherries with cream sauce, foxberries, peach dessert..... ☐

Raw fresh fruits or vegetables, like apples, onions, oranges, tomatoes ☐

Beans, Soups=====

Black beans..... ☒

Chicken consommé, cream of mushroom, hot and sour, minestrone, potato, tomato basil, vegetarian vegetable soup

Pureed pea soup, pureed vegetable soup..... ☐

Chicken noodle soup

Borsch with meat, cucumber soup, Kharcho mutton soup, meat and vegetable soup, noodle soup with meat.. ☐

Red beans and rice, split pea soup

Calories
Protein
Calcium
Sodium
Iron
Potassium
Fluid

Food Logs

Food Log

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
whey protein isolate decaf tea CS orange mango drink dried pears granola with raisons oatmeal with brown sugar almonds 12 crackers with PB waffle rhubarb applesauce red beans & rice tomato & basil soup chipotle wheat bread green beans & mushrooms tomatoes & artichokes vanilla pudding shortbread cookies	whey protein isolate lemon zinger tea peach apricot drink dried apricots cliff granola bar vegi quiche macadamia nuts lasagna vegivegi soup teriyaki vegi homestyle potatoes wheat bread meatloaf tomatoes & eggplant hint of lime	whey protein isolate lemon zinger tea grape drink pineapple oatmeal and brown sugar cornflakes creamed spinach chicken noodle soup chipotle bread southwestern corn corn green beans and mushrooms cauliflower and cheese tortillas seafood gumbo shrimp cocktail trail mix banana pudding strawberries	whey protein isolate decaf tea CS orange juice granola barx2 zone strawberry yogurt bar 8 crackers minestrone tuna light tortillas teriyaki vegis salted almonds pears teriyaki steak italian vegis homestyle potatoes wafflesx2 strawberries	whey protein isolate lemon zinger corn flakes oatmeal and brown sugar orange drink 2xgranola bars dried pears zucchini spread tortillas teriyaki vegis beef & vegi casserole baked beans chicken nugget jerkey	whey protein isolate lemon zinger grapefruit drink oatmeal with raisins scrambled eggs fruit cocktail 12 crackers tomato & basil soup mac & cheese corn teriyaki vegis cauliflower & cheese sweet & sour pork rice & butter vanilla pudding waffles	whey protein isolate decaf tea CS orange juice granola bar oatmeal & brown sugar oatmeal raisin & spice pears chicken noodle soup 8 crackers beef ravioli beef fajitas tortillas tomato & eggplant 3 brie 8 crackers potatoes au gratin
1000 IU Vitamin D	1000 IU Vitamin D	1000 IU Vitamin D	1000 IU Vitamin D	1000 IU Vitamin D	1000 IU Vitamin D	1000 IU Vitamin D

Water, Vitamin D

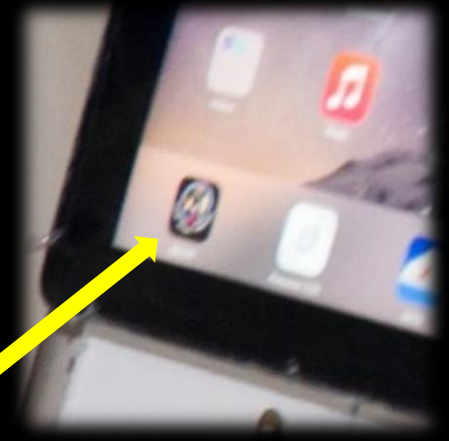
Dietary Intake Tracking ISS FIT



- iPad App developed and is currently in ground testing (45 day missions)
- Used to track all dietary intake in ground studies and flight.
- ISS FIT arrived on station early August, 2016



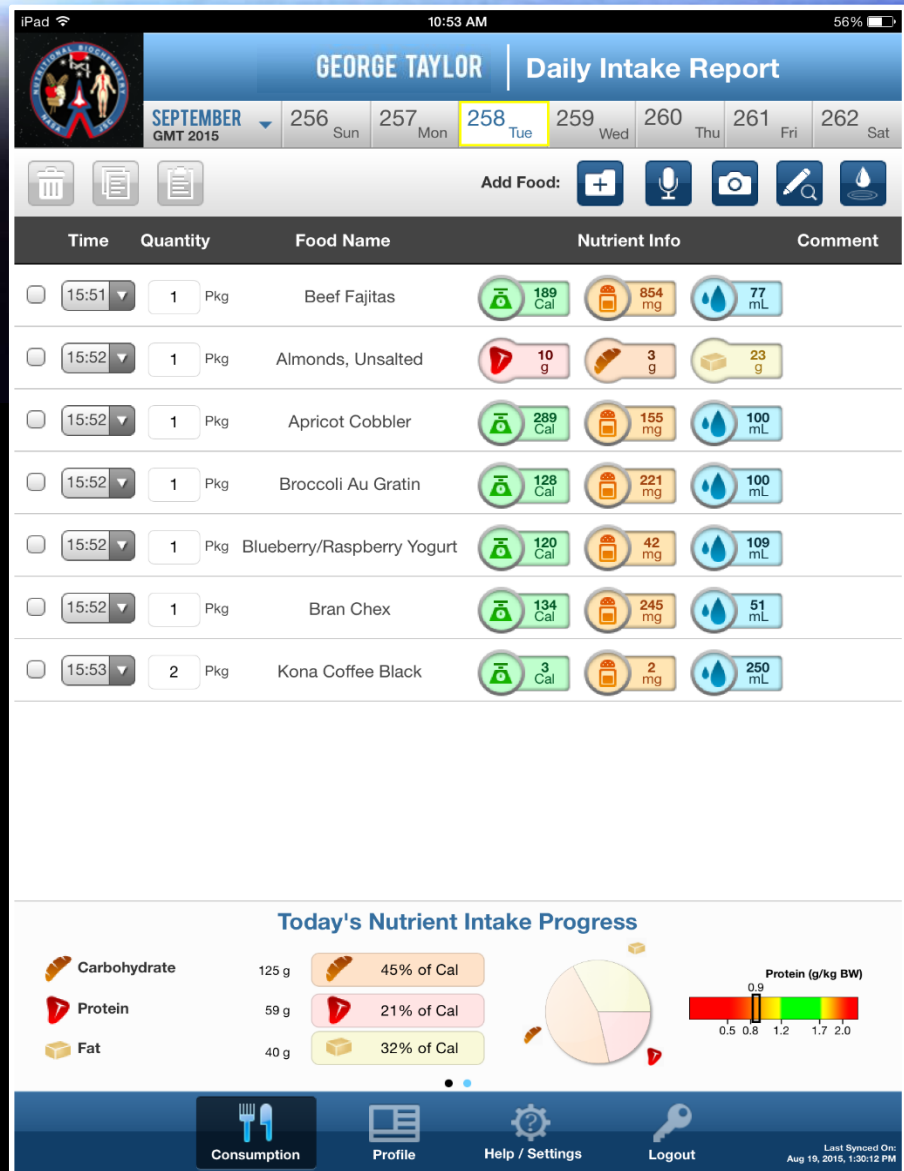
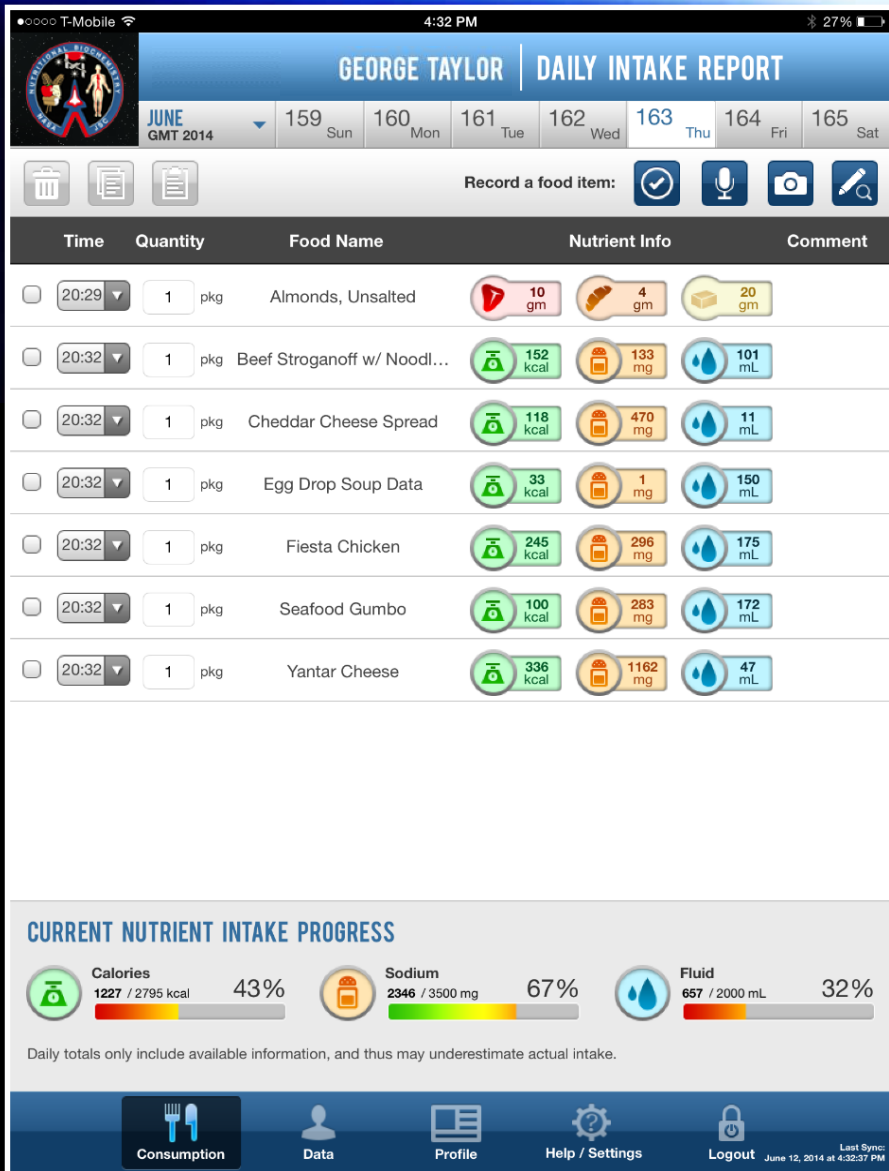
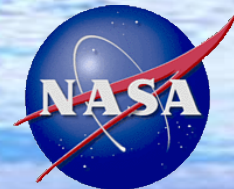
ISS FIT on Station!



Data from the app will provide us a better insight into the nutritional intake of the crew and will provide the crew real time feed back on their daily intake.



ISS FIT



NDSR 2015 Foods Report

Project Abbrev:

Participant ID: _____ Date of Intake: _____

8.00a OTHER WORK

1. Granola w/ Raisins (R) (GranolawRai)
1 serving eaten (serving = 140.24 g)
2. Raspberry Lemonade w/ S/S product name changed to Sugar Substitute (RaspLem w/SS)
1 serving eaten (serving = 251.5 grams)
3. special formulated products, bars or wafers, high-protein bar, Clif Builder's 20g Protein Bar - Chocolate Peanut Butter
1 bar - each 2.4 OZ
4. Hint of Orange (Hint of Oran)
1 serving eaten (serving = 250.7 grams)
5. Green Tea w/ Sugar 2 (GreenTeaSug2)
1 serving eaten (serving = 255 grams)
6. Tuna Creations Hickory Smoked by Starkist Label Data Built (StarTunCrHS))
1 serving eaten (serving = 74 grams)
7. Fruit Cocktail in P 3 (T) (Fruit CockP3)
1 serving eaten (serving = 128 g)
8. Wild Rice Salad (WildRiceSal)
1 serving eaten (serving = 120 grams)
9. Starkist Tuna Creations Sweet & Spicy (TunaCreSweSp)
1 serving eaten (serving = 1 pouch (74 G))
10. Grape Drink w/ SS Imputed 2 Name change (GrapeDrSS2)
1 serving eaten (serving = 251.508 grams)
11. cranberries, dried (Craisins)
1 OZ (0.24 CP)
12. Black Beans 2 LS (BlackBean2LS)

Main Folder
Page 1 of 2

Report

❖ All data received from ISS FIT is entered into NDSR for nutrient analysis on a weekly basis.

❖ FFQ report worked up and sent to flight surgeon.

NDSR 2015 Foods Report

Project Abl

Participant _____ Date of In _____

- 1 serving eaten (serving = 170 grams)
13. Hint of Lime (Hint of Lime)
1 serving eaten (serving = 250.8 grams)
14. Rice w/ Butter 2 LS (RiceButte2LS)
1 serving eaten (serving = 115 grams)
15. Fruit Cocktail in P 3 (T) (Fruit CockP3)
1 serving eaten (serving = 128 g)
16. Sweet & Sour Pork 2 LS (SweetSourPo2)
1 serving eaten (serving = 198 grams)
17. Raspberry Lemonade w/ S/S product name changed to Sugar Substitute (RaspLem w/SS)
1 serving eaten (serving = 251.5 grams)
18. peanut butter, reduced fat
1 TB
19. Gummy Candy by Haribo Label data Built (GummyCandy)
1 serving eaten (serving = 1 oz.)
20. supplements - used for fortification, vitamins, vitamin D (calciferol), as vitamin D3 (cholecalciferol)
1000 international unit (250.00 % Daily Value - each 100% = 400 IU)

[End of Record]

Legend: a = addition; i = component/ingredient; v = variable; ? = incomplete; M = missing food;
PN = priority note

Main Folder
Page 2 of 2

Full Nutrient Analysis

NDSR

NDSR 2015 Averag

Project Abbreviation:	Comment:
Primary Energy Sources	
Energy (kilocalories)	1836 kcal
Energy (kilojoules)	7764 kJ
Total Fat	52.129 g
Total Carbohydrate	268.956 g
Available Carbohydrate	241.977 g
Total Protein	86.467 g
Animal Protein	47.923 g
Vegetable Protein	37.488 g
Alcohol	0.056 g
% Calories from Fat	25.012 %
% Calories from Carbohydrate	57.312 %
% Calories from Protein	18.282 %
% Calories from Alcohol	0.011 %
Fat and Cholesterol	
Cholesterol	197 mg
Solid Fat	5.534 g
Total Saturated Fatty Acids (SFA)	13.033 g
Total Monounsaturated Fatty Acids (MUFA)	19.178 g
Total Polyunsaturated Fatty Acids (PUFA)	12.212 g
Total Trans Fatty Acids (TRANS)	0.802 g
Total Conjugated Linoleic Acid (CLA 18:2)	0.029 g
Omega-3 Fatty Acids	0.668 g
% Calories from SFA	7.231 %
% Calories from MUFA	9.296 %
% Calories from PUFA	5.834 %
Polyunsaturated to Saturated Fat Ratio	0.812
Cholesterol to Saturated Fatty Acid Index	22.010
Carbohydrates	
Total Sugars	123.154 g
Fraction	14.213 g
Glucose	0.319 g
Glucose	20.199 g
Lactose	3.364 g
Maltose	6.659 g
Sucrose	78.450 g
Starch	103.288 g
Added Sugars (by Total Sugars)	56.970 g
Added Sugars (by Available Carbohydrate)	100.991 g
Fiber	
Total Dietary Fiber	22.453 g
Soluble Dietary Fiber	7.729 g
Insoluble Dietary Fiber	17.404 g
Main Folder	
Page 1 of 5	Printed: 12/16/2016 12:11

NDSR

NDSR 2015

Project Abbreviation:	Comment:
Fiber	
Pectin	2.642 g
Minerals	
Total Vitamin A Activity (Retinol Equivalents)	1022 mcg
Total Vitamin A Activity (International Units)	7795 IU
Total Vitamin A Activity (Retinol Activity Equivalents)	692 mcg
Beta-Carotene Equivalents (derived from provitamin A carotenoids)	3953 mcg
Retinol	363 mcg
Vitamin D (calciferol)	27.805 mcg
Vitamin D2 (ergocalciferol)	6.215 mcg
Vitamin D3 (cholecalciferol)	26.517 mcg
Vitamin E (International Units)	35 IU
Vitamin E (Total Alpha-Tocopherol)	20.808 mcg
Natural Alpha-Tocopherol (RRR-alpha-tocopherol or d-alpha-tocopherol)	15.768 mcg
Synthetic Alpha-Tocopherol (all rac-alpha-tocopherol or dl-alpha-tocopherol)	11.312 mcg
Total Alpha-Tocopherol Equivalents	27.996 mcg
Beta-Tocopherol	0.405 mcg
Gamma-Tocopherol	7.476 mcg
Delta-Tocopherol	0.725 mcg
Vitamin K (phylloquinone)	66.721 mcg
Vitamin C (ascorbic acid)	179.653 mcg
Thiamin (vitamin B1)	1.480 mcg
Riboflavin (vitamin B2)	1.745 mcg
Niacin (vitamin B3)	29.768 mcg
Niacin Equivalents	45.979 mcg
Pantothenic Acid	4.739 mcg
Vitamin B6 (pyridoxine, pyridoxyl, or pyridoxamine)	2.978 mcg
Total Folate	543 mcg
Dietary Folate Equivalents	783 mcg
Natural Folate (Food folate)	200 mcg
Synthetic Folate (folic acid)	343 mcg
Vitamin B12 (cobalamin)	7.034 mcg
Carotenoids	
Beta-Carotene (provitamin A carotenoid)	3412 mcg
Alpha-Carotene (provitamin A carotenoid)	766 mcg
Beta-Cryptoxanthin (provitamin A carotenoid)	313 mcg
Lutein + Zeaxanthin	1124 mcg
Lycopene	2.461 mcg
Minerals	
Calcium	821 mg
Phosphorus	1232 mg
Magnesium	333 mg
Iron	18.435 mg
Main Folder	
Page 2 of 5	Printed: 12/16/2016 12:11

NDSR

NDSR 2015 Averag

Project Abbreviation:	Comment:
Minerals	
Zinc	10.542 mg
Copper	1.440 mg
Manganese	4.265 mg
Selenium	133.538 mcg
Sodium	1824 mg
Potassium	2545 mg
Fatty Acids	
SFA 4:0 (butyric acid)	0.400 g
SFA 6:0 (caproic acid)	0.249 g
SFA 8:0 (caprylic acid)	0.255 g
SFA 10:0 (capric acid)	0.399 g
SFA 12:0 (lauric acid)	0.998 g
SFA 14:0 (myristic acid)	1.402 g
SFA 16:0 (palmitic acid)	7.350 g
SFA 18:0 (stearic acid)	0.088 g
SFA 18:1 (oleic acid)	3.061 g
SFA 20:0 (arachidic acid)	0.119 g
SFA 22:0 (behenic acid)	0.145 g
MUFA 14:1 (myristoleic acid)	0.020 g
MUFA 16:1 (palmitoleic acid)	0.511 g
MUFA 18:1 (oleic acid)	18.261 g
MUFA 20:1 (gadololeic acid)	0.197 g
MUFA 22:1 (erucic acid)	0.032 g
PUFA 18:2 (linoleic acid)	10.882 g
PUFA 18:3 (linolenic acid)	0.967 g
PUFA 18:3 n-3 (alpha-linolenic acid [ALA])	0.489 g
PUFA 18:4 (stearidonic acid)	0.001 g
PUFA 20:4 (arachidonic acid)	0.108 g
PUFA 20:5 (eicosapentaenoic acid [EPA])	0.026 g
PUFA 22:5 (docosapentaenoic acid [DPA])	0.023 g
PUFA 22:6 (docosahexaenoic acid [DHA])	0.138 g
TRANS 16:1 (trans-hexadecenoic acid)	0.006 g
TRANS 18:1 (trans-octadecenoic acid)	0.618 g
TRANS 18:2 (trans-octadecadienoic acid)	0.142 g
CLA cis-9, trans-11	0.024 g
CLA cis-9, trans-10, cis-12	0.005 g
Amino Acids	
Tryptophan	0.973 g
Threonine	3.299 g
Isoleucine	3.832 g
Leucine	6.536 g
Lysine	5.907 g
Main Folder	
Page 3 of 5	Printed: 12/16/2016 12:11

NDSR

NDSR 2015.1

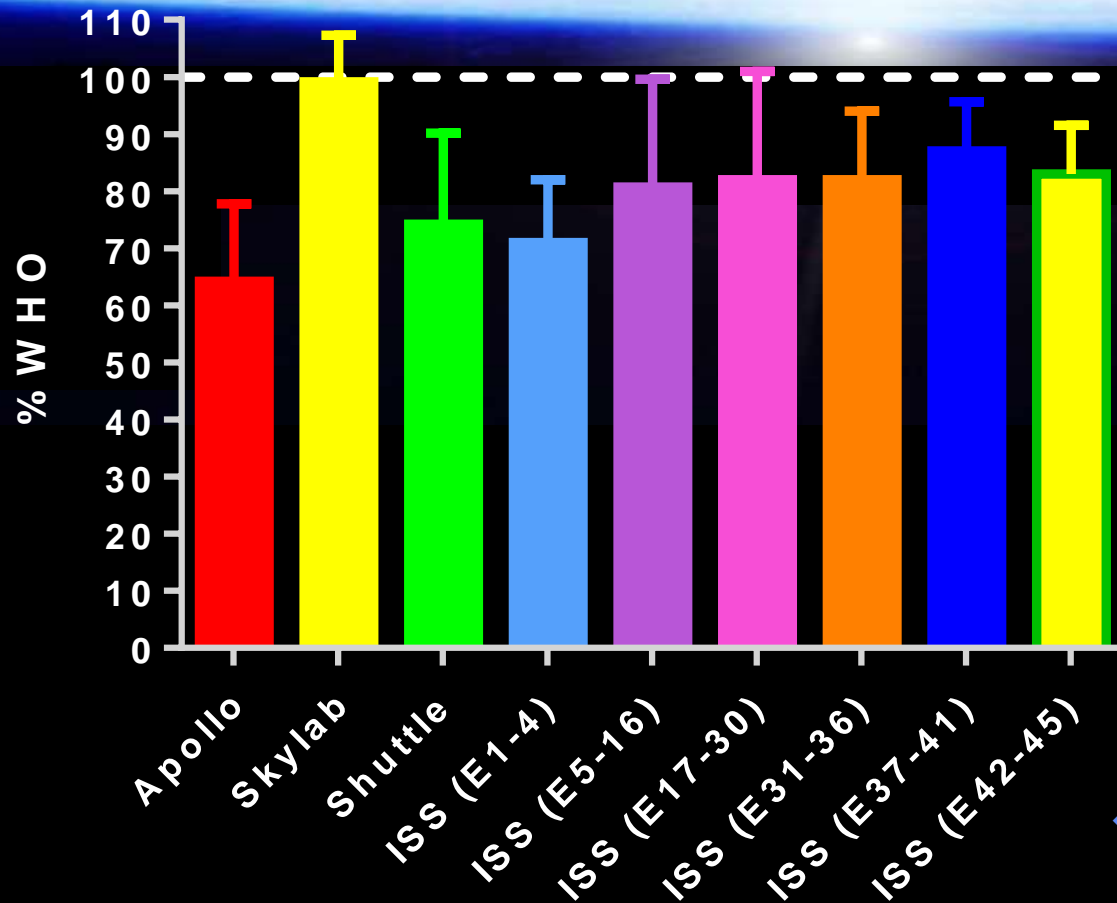
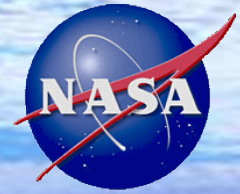
Project Abbreviation:	Comment:
Amino Acids	
Methionine	1.848 g
Cysteine	1.143 g
Phenylalanine	3.761 g
Tyrosine	2.898 g
Valine	4.244 g
Asparagine	5.637 g
Glutamine	2.339 g
Alanine	4.238 g
Aspartic Acid	8.442 g
Glutamic Acid	15.589 g
Glycine	3.956 g
Proline	4.368 g
Serine	3.887 g
Enzymes and Similar	
Threonine	5.471 mg
Glutamine	6.282 mg
Glycine	1.456 mg
Cysteine	0.013 mg
Biochemical A	0.036 mg
Formocortin	0.001 mg
Sugar Alcohols (sorbitol)	
Erythritol	0.000 g
Inositol	0.041 g
Isomalt	0.000 g
Lactitol	0.000 g
Maltitol	0.010 g
Mannitol	0.373 g
Psyllium	0.026 g
Sorbitol	0.893 g
Xylitol	0.006 g
Other	
Ascorbic Acid Potassium	66.571 mg
Algalinate	15.343 mg
Saccharin	0.000 mg
Sucralose	34.089 mg
Tapioca	1.436 mg
Caffeine	43 mg
Phytic Acid	1250.847 mg
Oxalic Acid	192.350 mg
3-Methylcrotonic	13.837 mg
Sucrose Polyester	0.000 g
Choline	264.997 mg
Main Folder	
Page 4 of 5	Printed: 12/16/2016 12:11

NDSR

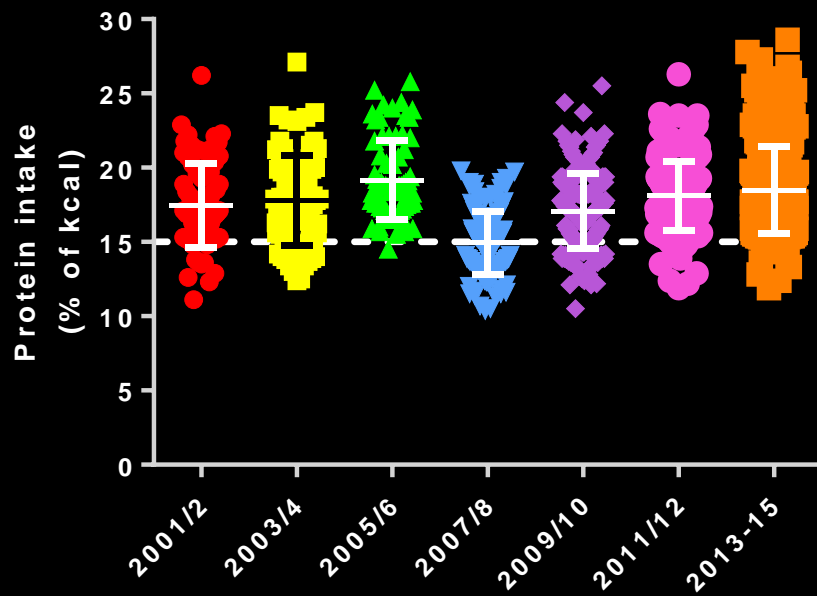
NDSR 2015.1

Project Abbreviation:	Comment:
Other	
Betaine	88.373 mg
Glycemic Index (glucose reference)	31
Glycemic Index (bread reference)	45
Glycemic Load (glucose reference)	74
Glycemic Load (bread reference)	106
Nitrogen	6.147 g
Alk	12.520 g
Water	1899.783 g
Growth	2897.817 g
Fast Nutrients	
Use Nutrient 1	0.09951 mg
Use Nutrient 2	0.00000 mg
Use Nutrient 3	1772.96718 mg
Use Nutrient 4	5.50000 mg
Use Nutrient 5	0.00000 mg
Use Nutrient 6	0.00000 mg
Use Nutrient 7	67.57871 mg
Use Nutrient 8	0.00000 mg
Use Nutrient 9	0.00000 mg
Use Nutrient 10	0.00000 mg
Use Nutrient 11	0.00000 mg
Use Nutrient 12	0.00000 mg
Use Nutrient 13	0.00000 mg
Use Nutrient 14	0.00000 mg
Use Nutrient 15	0.00000 mg
Use Nutrient 16	0.00000 mg
Use Nutrient 17	0.00000 mg
Use Nutrient 18	0.00000 mg
Use Nutrient 19	0.00000 mg
Use Nutrient 20	0.00000 mg
Note: DGLD nutrients are not included in these totals. Nutrient totals may not equal the sum of their parts. Refer to the NDSR User Manual.	
Main Folder	
Page 5 of 5	Printed: 12/16/2016 12:11

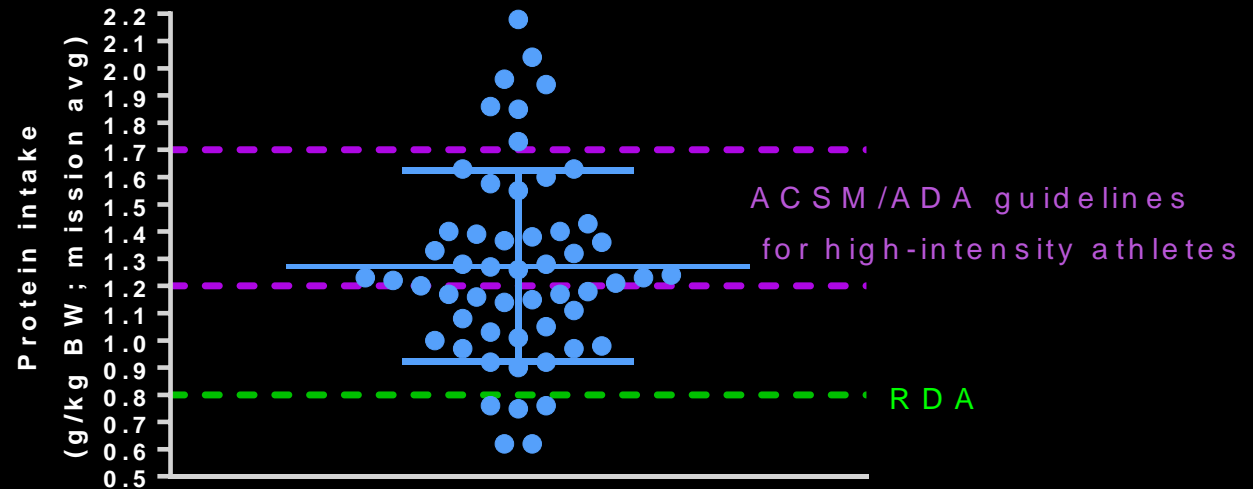
Energy



- ❖ Inadequate food intake can lead to:
 - ❖ Cardio decrements
 - ❖ Bone Loss
 - ❖ Muscle Loss



Protein Intake

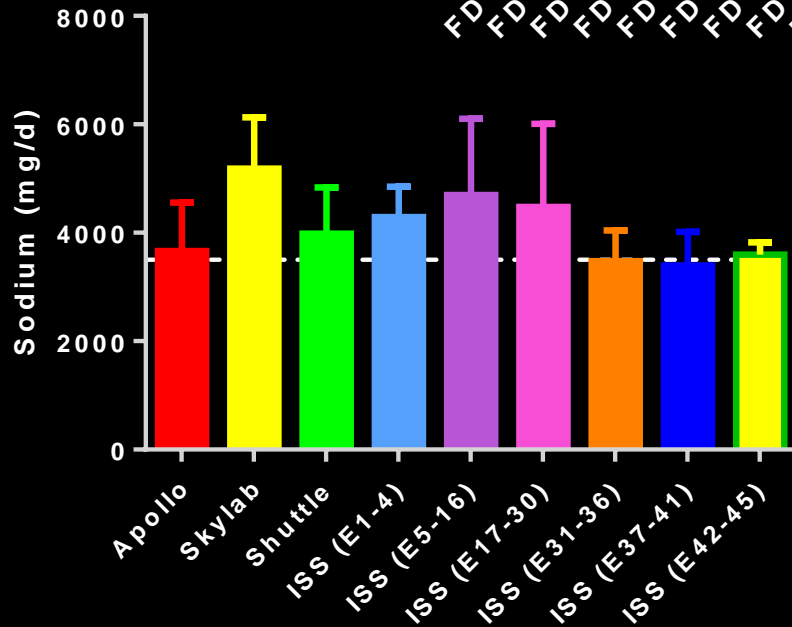
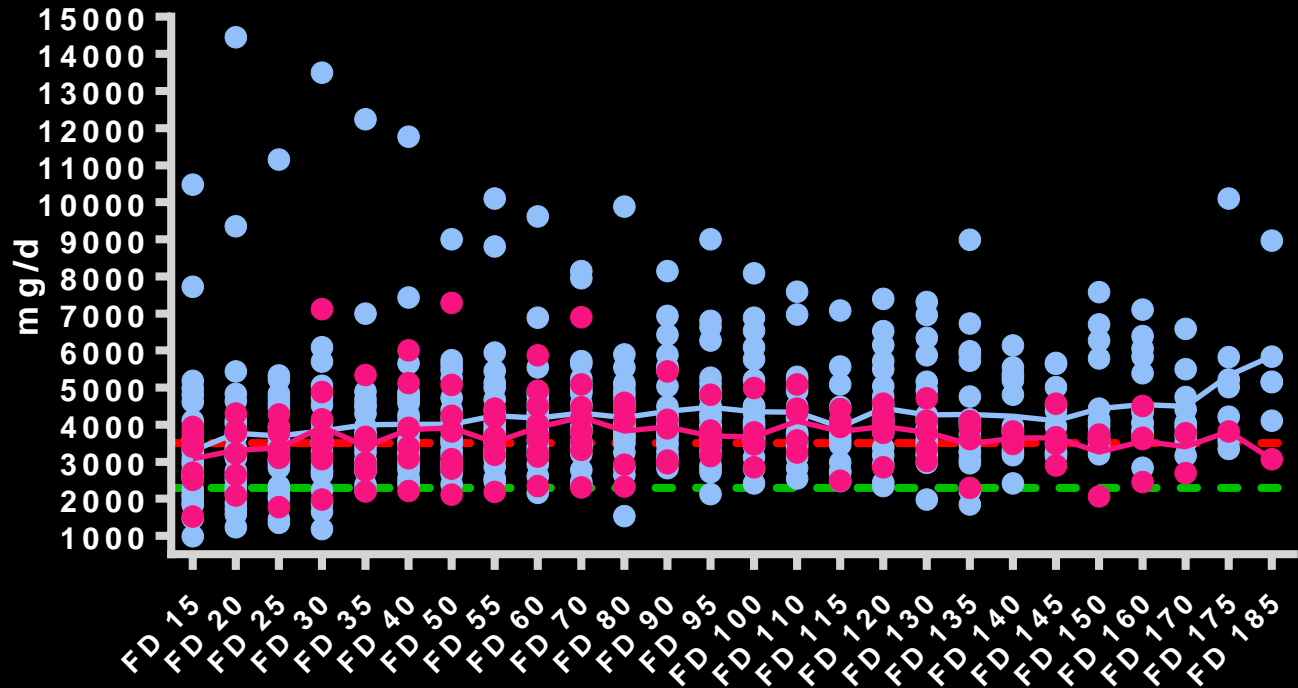


Excess protein cannot be stored in the body. Any in excess of requirement is oxidized (broken down), and the byproducts lead to challenges for kidneys, bones, and other systems...

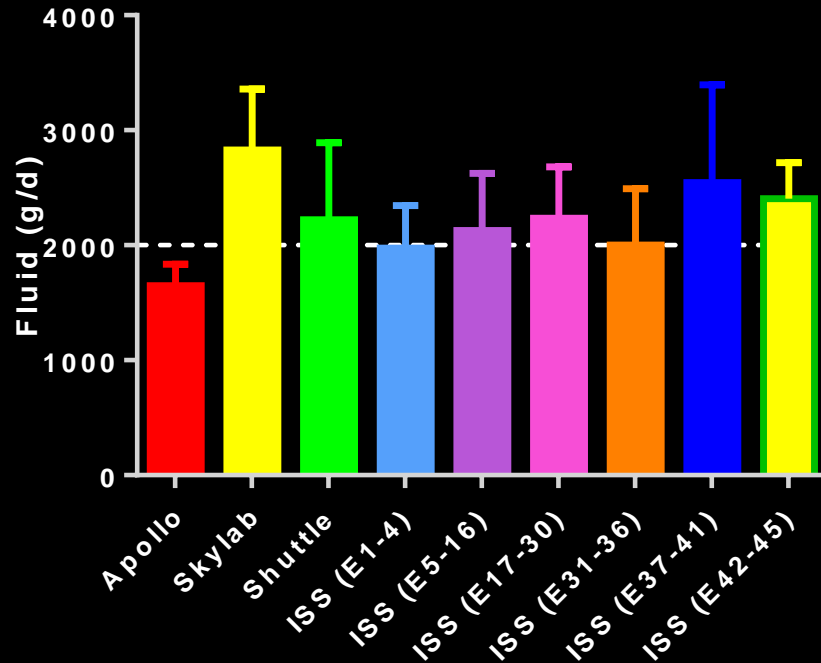
Male n=35

Female n=9

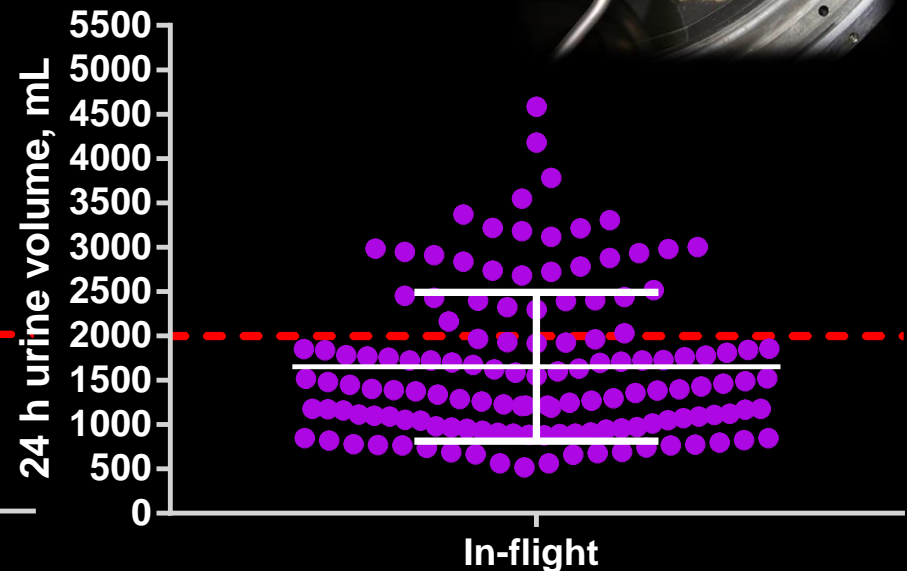
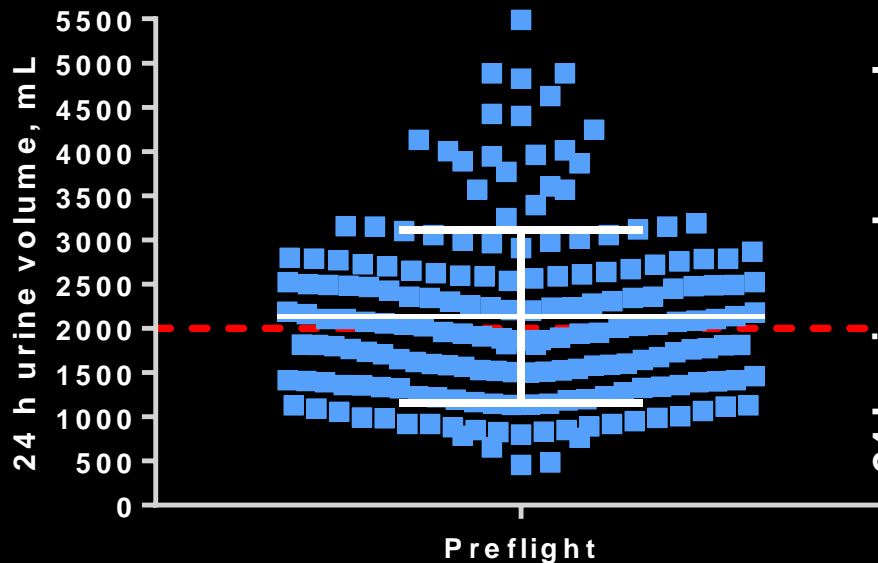
Sodium Intake



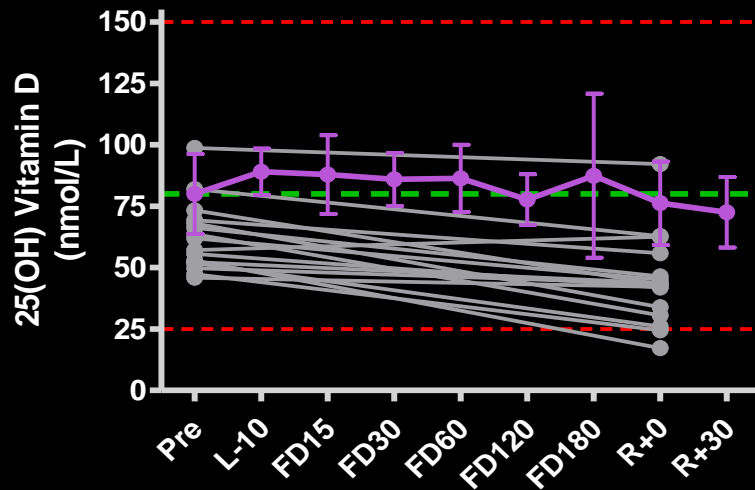
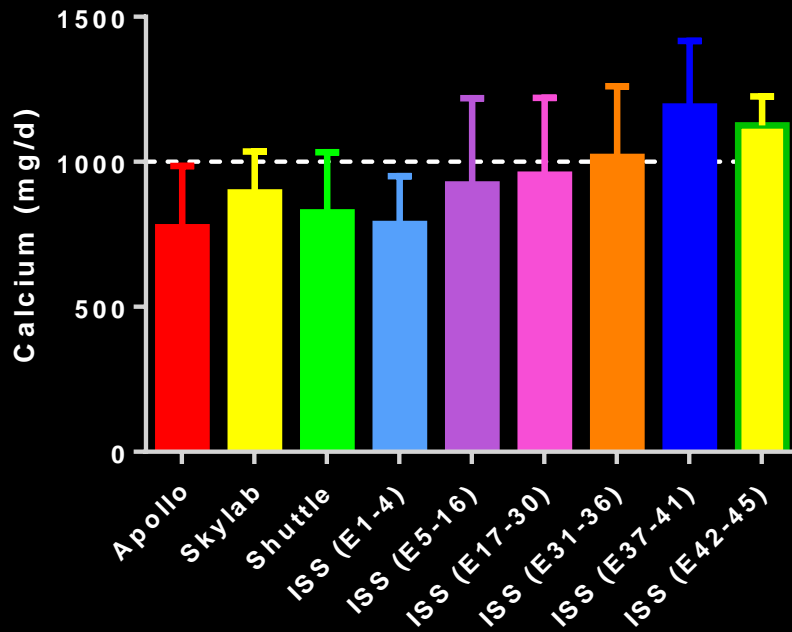
Fluid Intake & Urine Output



- ❖ Fluid intake is often inadequate during spaceflight
- ❖ Renal stone risk is elevated during and after spaceflight

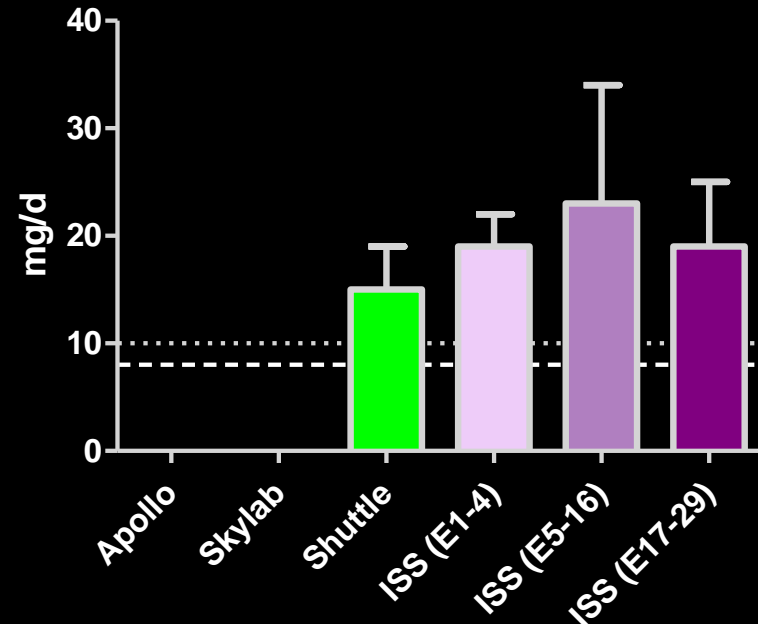


Nutrient Intake

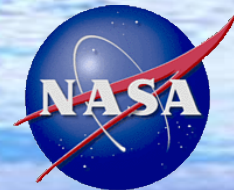


800 IU/day Vit D3 Supplement is enough to keep 25-Hydroxyvitamin D levels optimal inflight

Iron



❖ Iron content of the diet is a concern for crew health because of increased iron storage in the body.



SLAMMD

Space Linear Acceleration Mass
Measurement Device



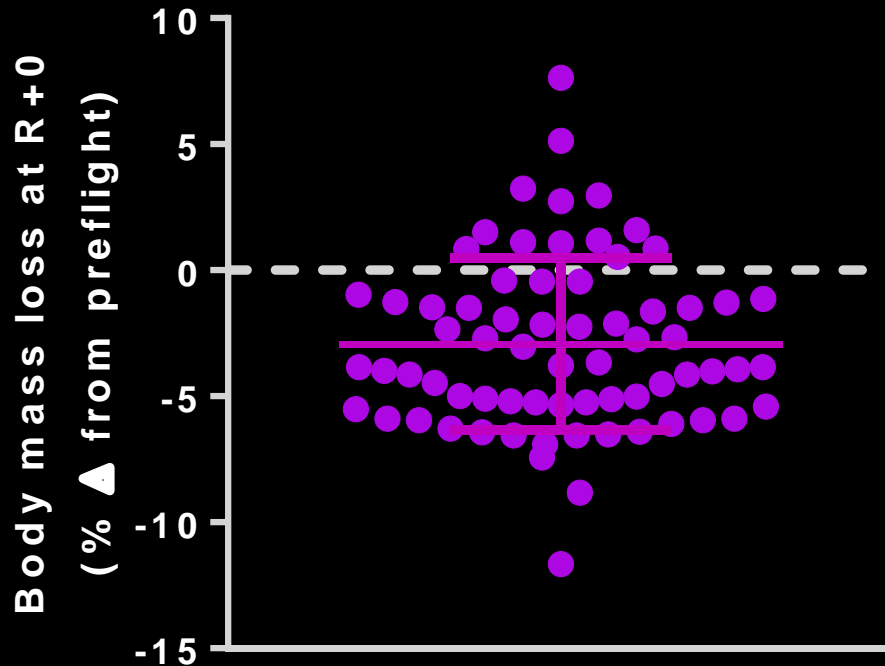
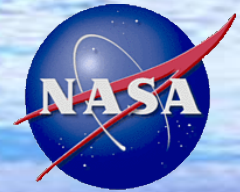
BMMD

Body Mass Measurement Device

Body Mass

Body Mass Loss

R+0



- ❖ Weight loss is a consistent finding during extended-duration missions
- ❖ Inadequate caloric intake impacts body mass loss, and likely exacerbates bone loss, muscle loss and other maladaptations

- ❖ % of crew with >10% weight loss: 1%
- ❖ % of crew with 5-10% weight loss: 33%

Resistance & Cardio

Treadmill



Cycle



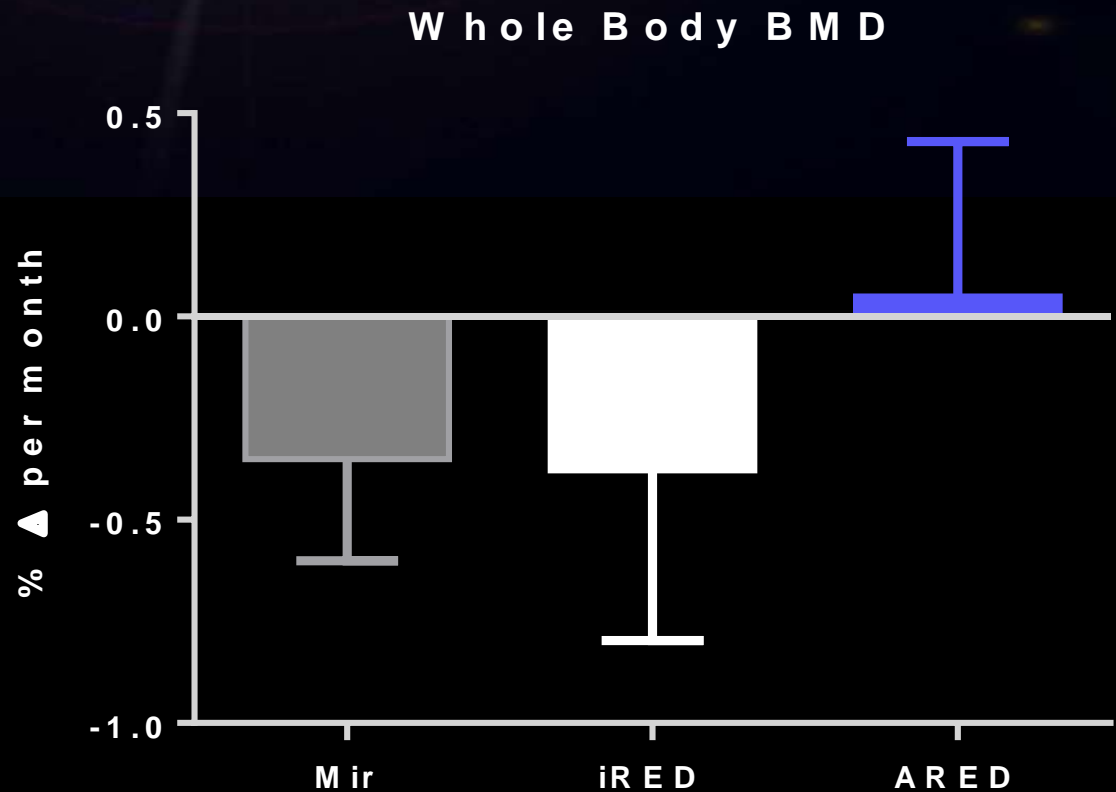
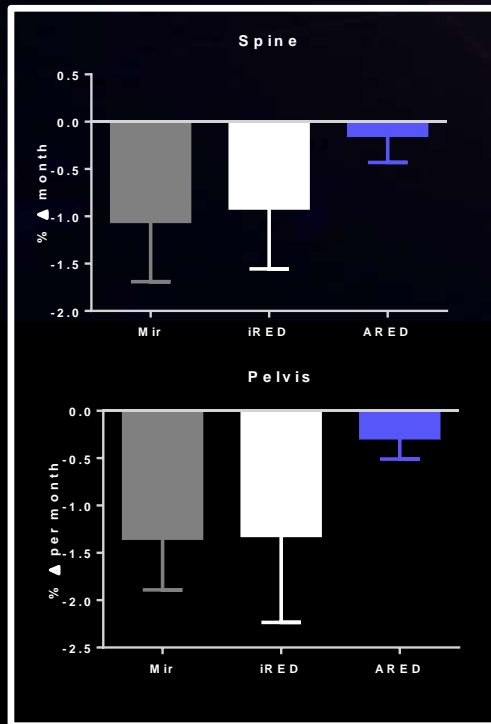
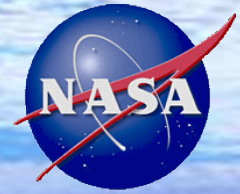
iRED



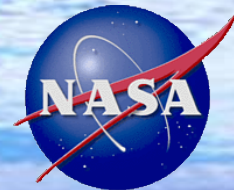
ARED



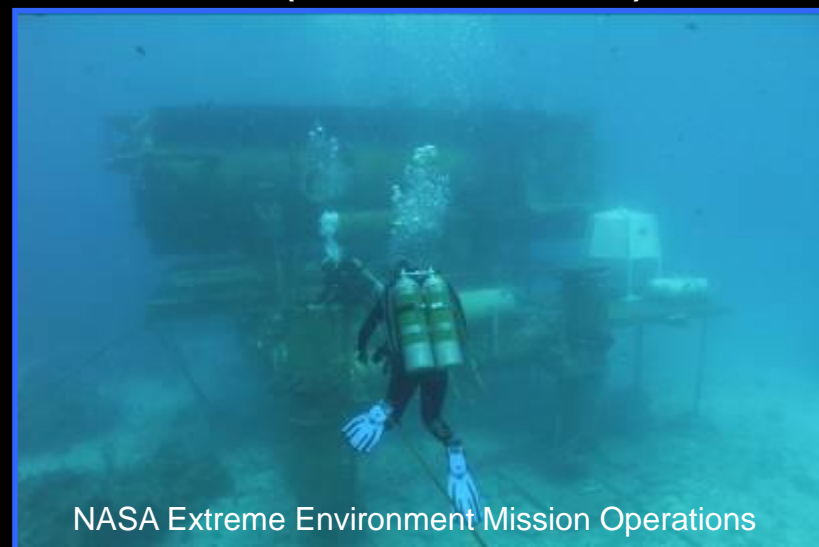
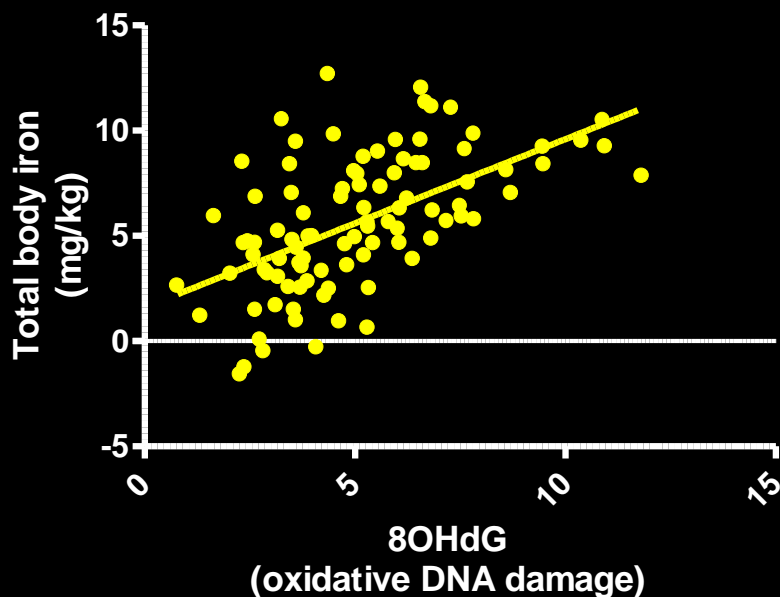
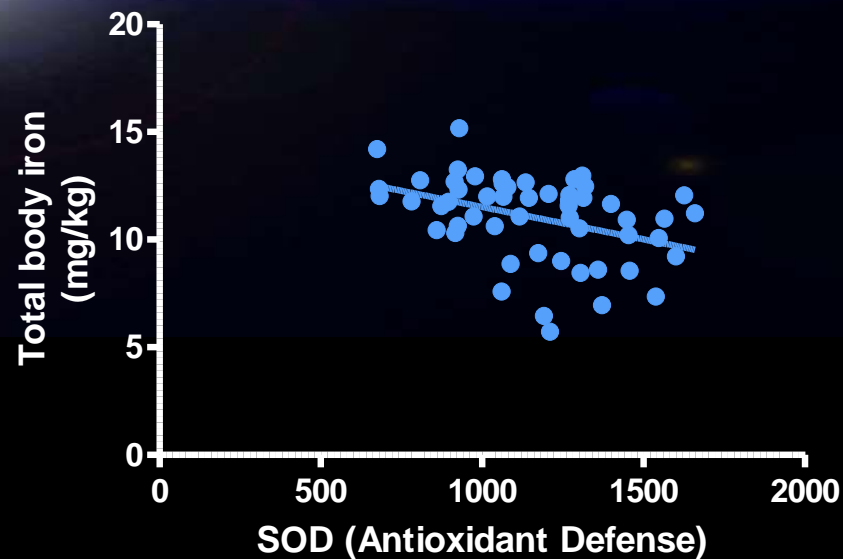
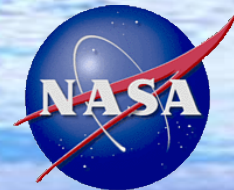
Bone Mineral Density



EVA

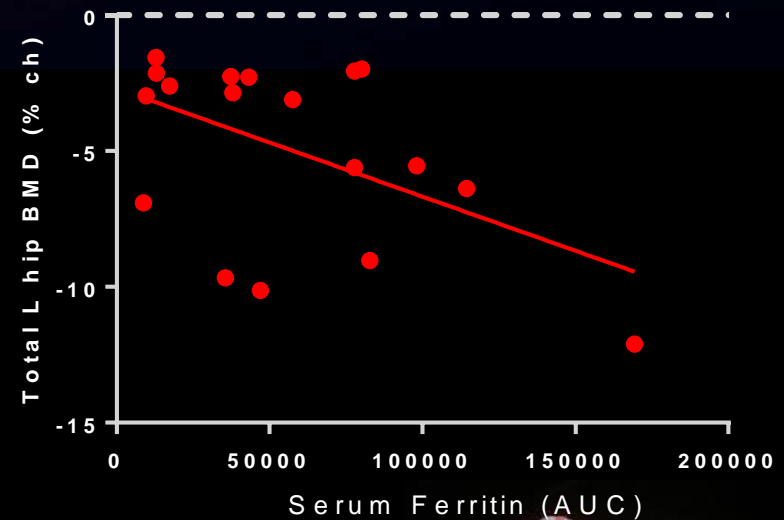
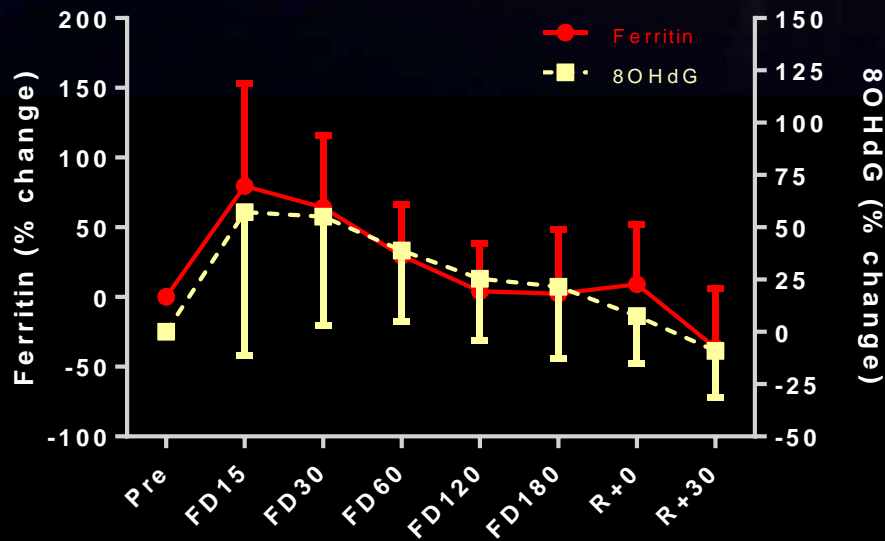
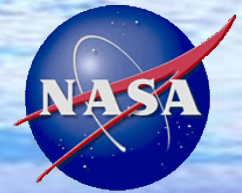


Iron and Oxygen Analogues



NASA Extreme Environment Mission Operations

Iron/Oxidative Damage/Bone



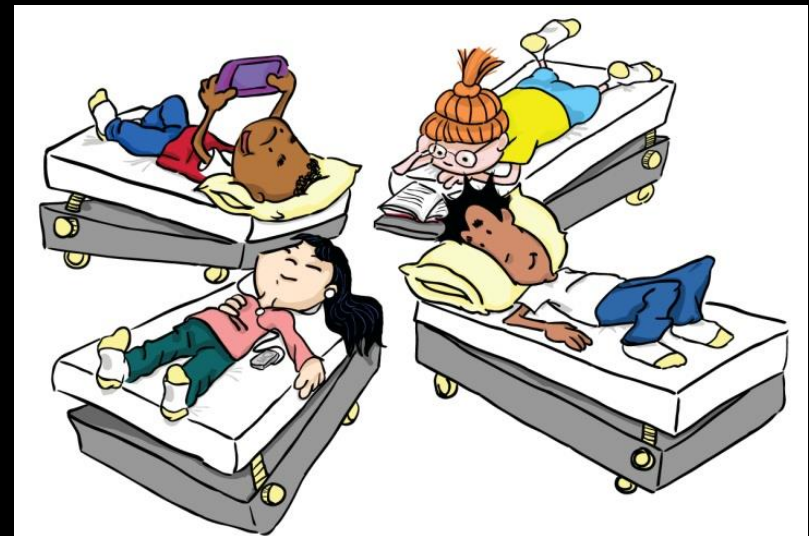
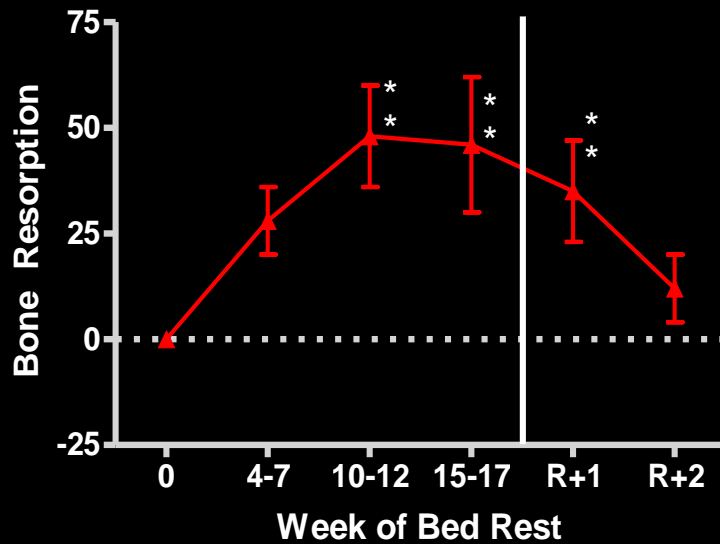
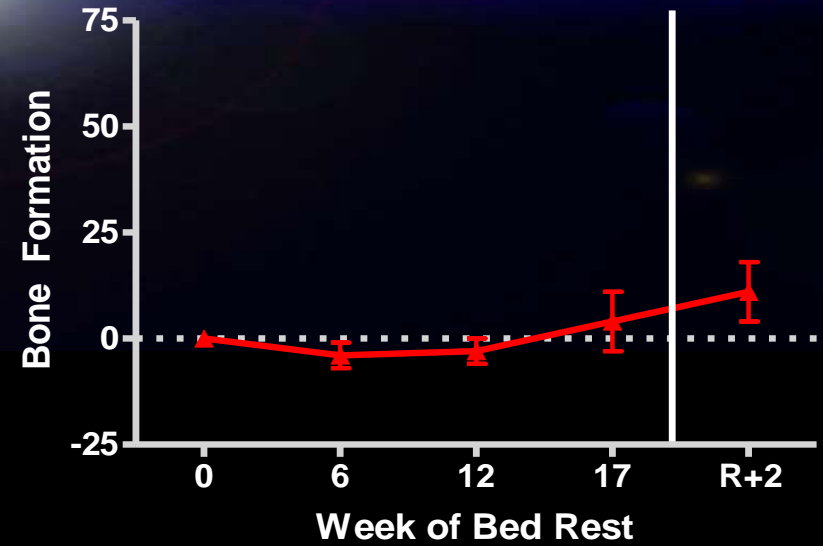
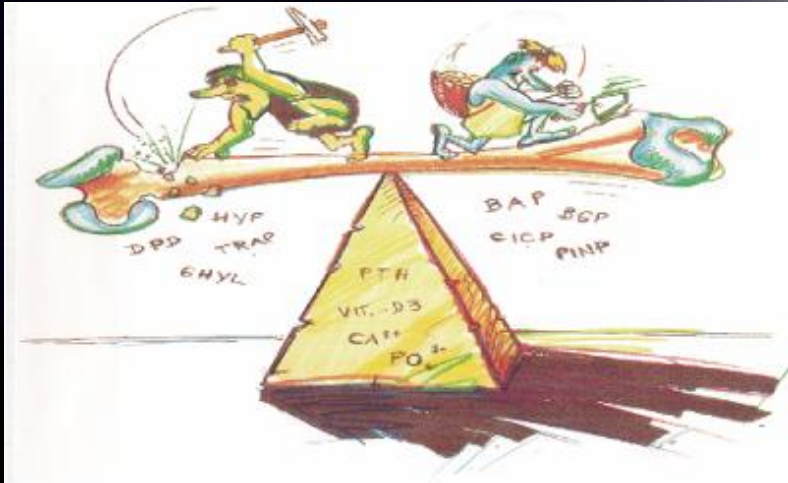
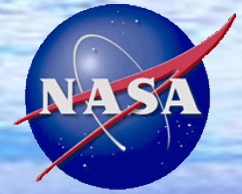
Increases in iron stores were paralleled by increases in oxidative damage to DNA (left). Increases in iron stores were correlated with regional bone loss (right).





Bone

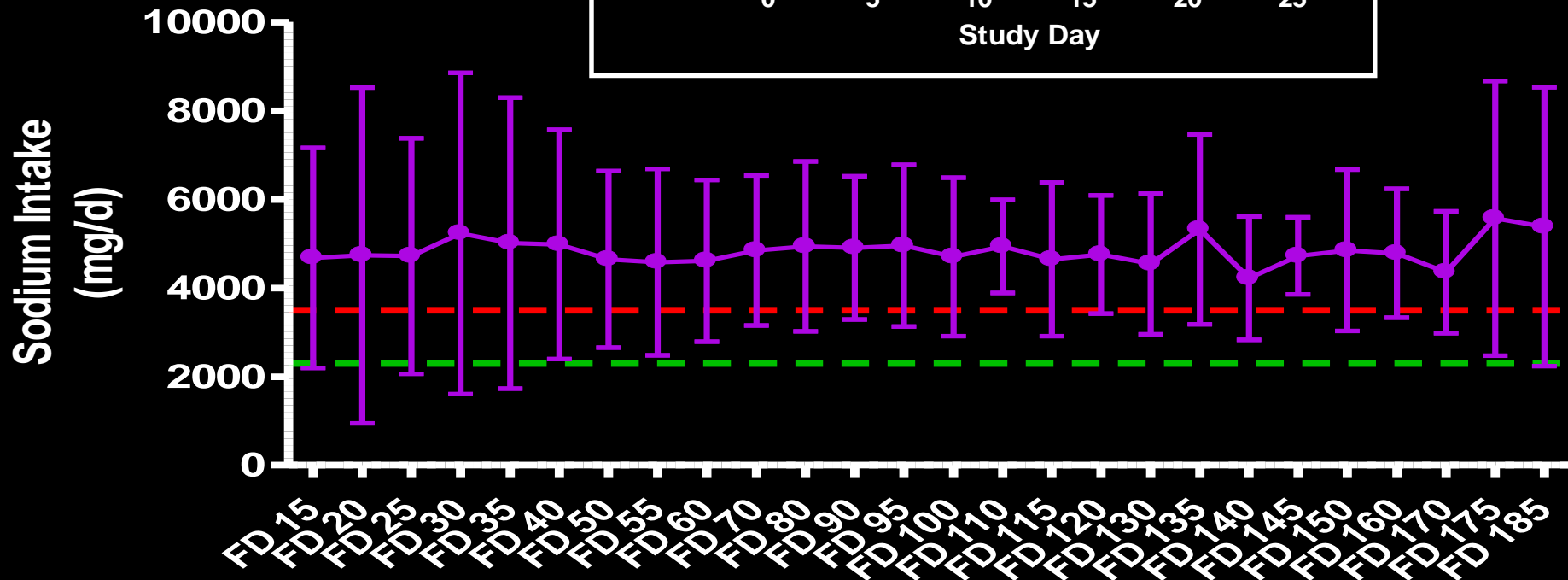
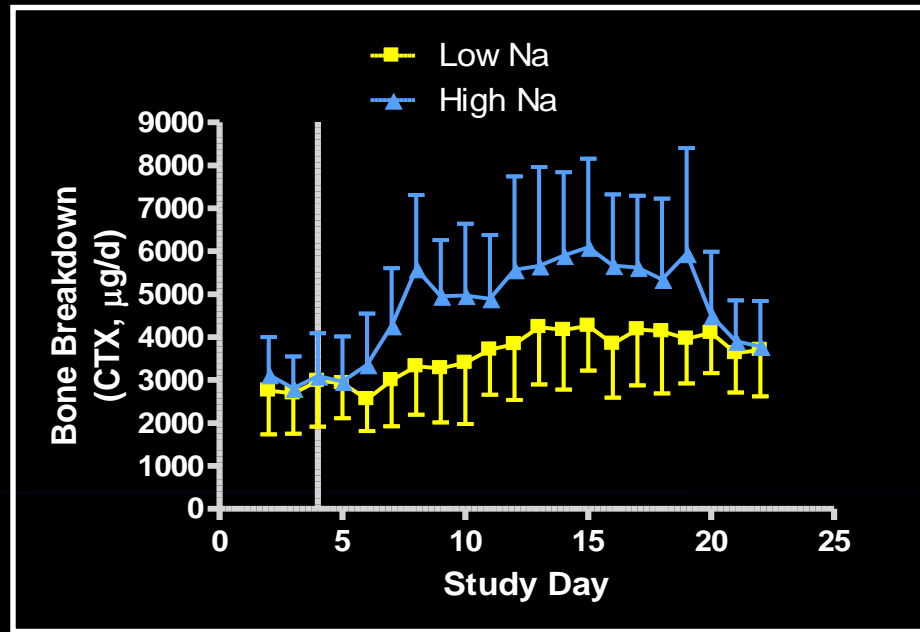
Bed Rest Study



Sodium and Bone

Heer, et al., 2008

SOLO



Vitamin D



Space Food



Flight Requirement (per day)

Vit D (IU)

600

Menu

172 ± 44

Salmon

396

Tuna

152

Breakfast Drink

116

Tuna Noodle Casserole

96

Cornflakes

88

Tuna Salad Spread

84

Bran Chex

68

Scrambled Eggs

64

Bread Pudding

56

Granola w/Raisins

44

Tapioca Pudding

44

Teriyaki Beef

36

Pork Chops

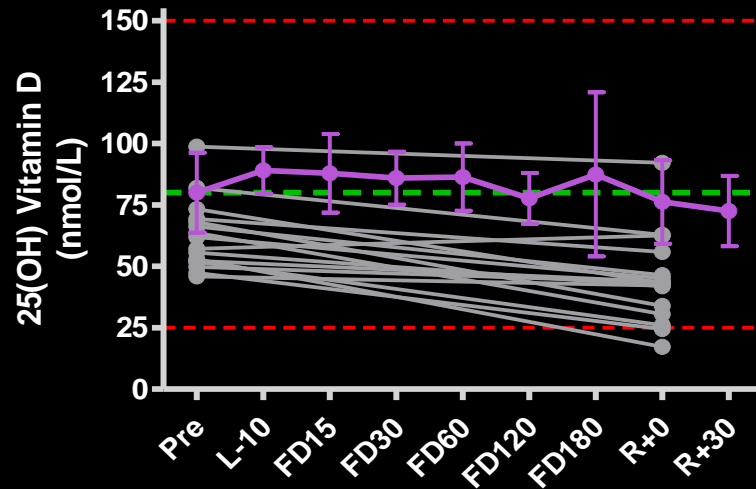
32

Vegetable Quiche

28

Potato Soup

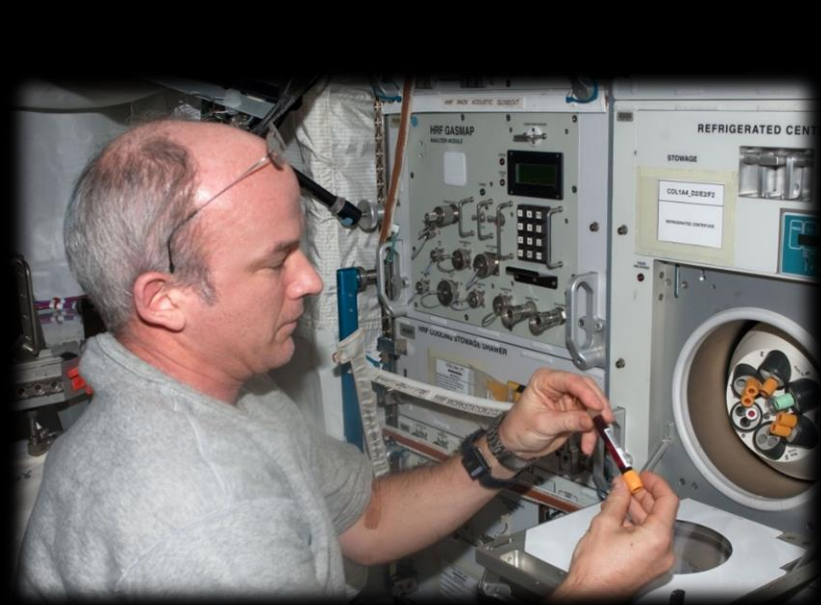
28



800 IU/day Vit D3 Supplement is enough to keep
25-Hydroxyvitamin D levels optimal inflight

Nutrition SMO 2006-2013



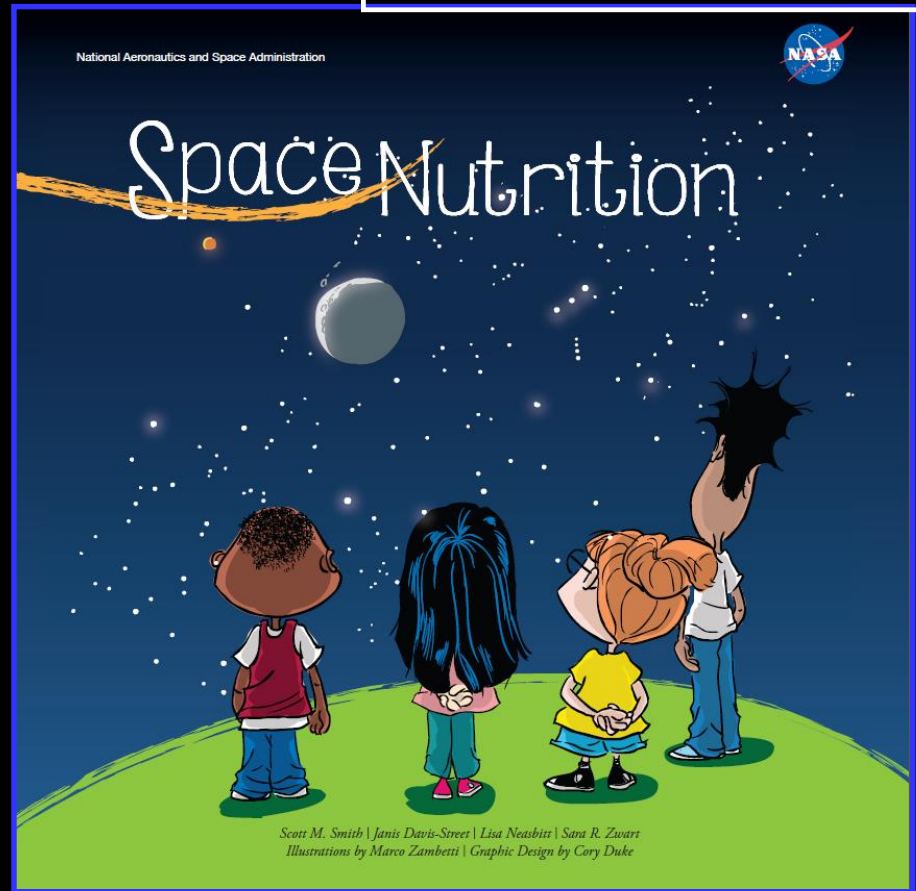
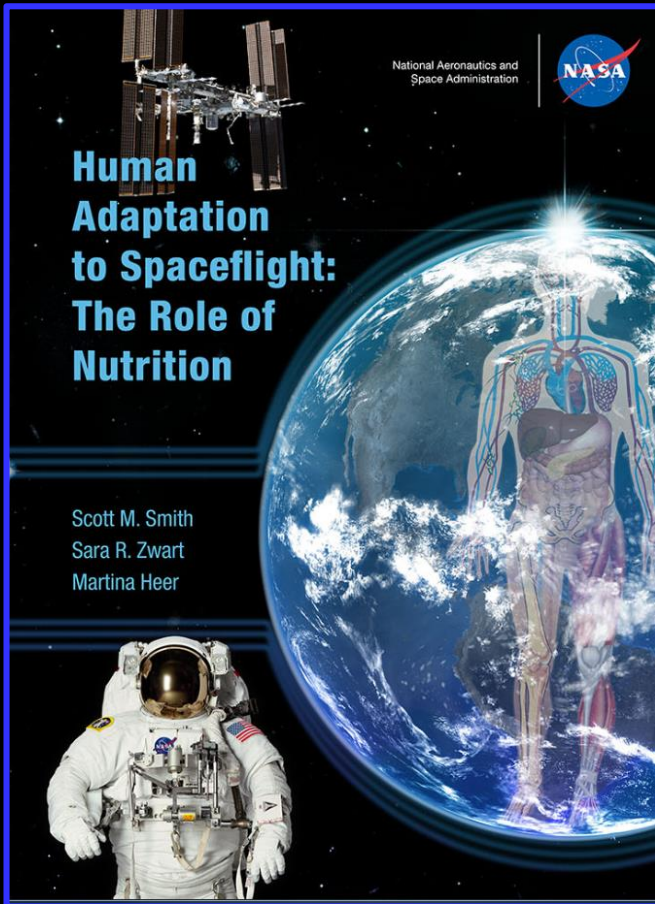


2013-Present

Biochem Profile

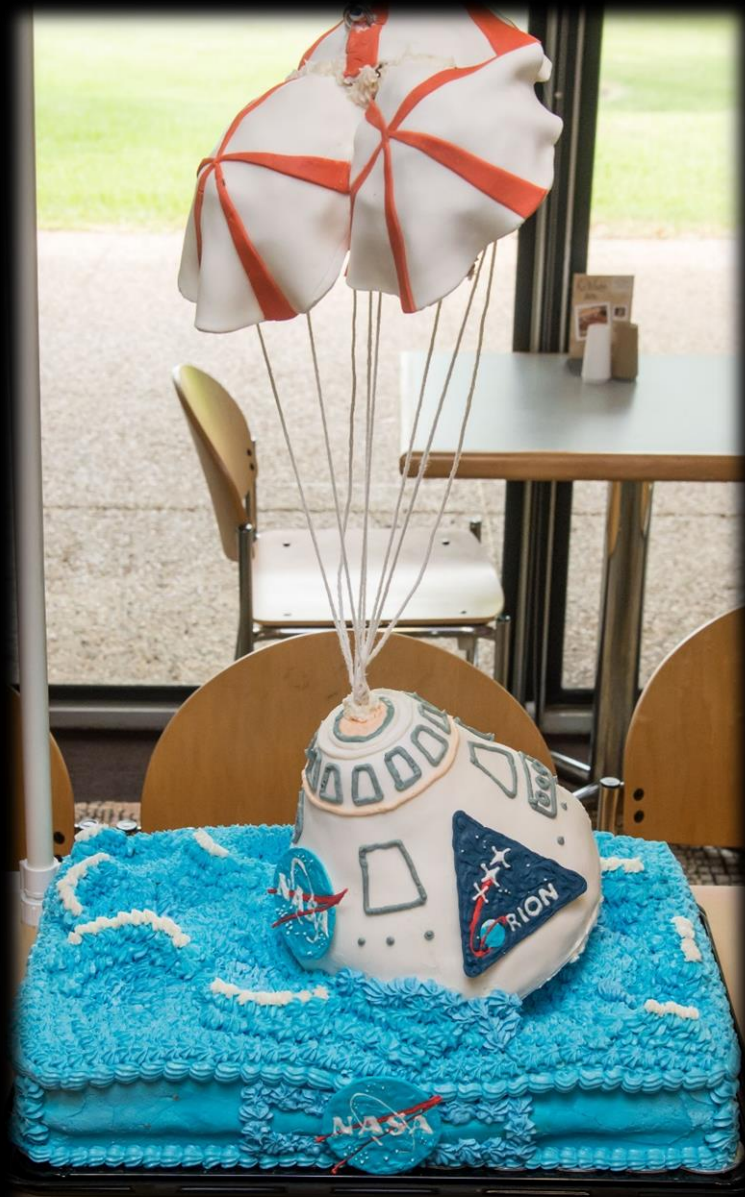


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Questions

